

ESTABLISHMENT OF SHOSSHONE SCULPIN (*COTTUS GREENEI*) IN A SPRING INHABITED BY MOTTLED SCULPIN (*C. BAIRDI*)

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ABSTRACT—The Shoshone sculpin (*Cottus greenei*) is found only in springs of the Thousand Springs formation along the Snake River in Idaho. In 1983 a small population of Shoshone sculpin was introduced into an unnamed spring in the Thousand Springs formation in an attempt to increase the range of the species. Previously, the only sculpin in that spring was the mottled sculpin (*Cottus bairdi*). The Shoshone sculpin was able to establish itself and become the predominant fish within 5 years.

Key words: Shoshone sculpin, *Cottus greenei*, mottled sculpin, *Cottus bairdi*, sympatric species, species of special concern, Snake River, Idaho

As of 1982, the Shoshone sculpin (*Cottus greenei*) was found in only 25 of 40 spring systems in the Thousand Springs formation near Hagerman in south central Idaho (Wallace et al. 1984). The species principally inhabits springs entering the north side of the Snake River from river kilometer 910.4 (relative to the mouth of the Snake River) upriver to kilometer 950.4. Because of its limited range and the extent of habitat modification, the Shoshone sculpin was proposed as a threatened or endangered species (Williams 1980). It is currently a candidate threatened or endangered species (W. E. Martin, U.S. Fish and Wildlife Service, Portland, Oregon; personal communication). The American Fisheries Society considers it "threatened" (Williams et al. 1989), and Idaho Department of Fish and Game considers the Shoshone sculpin a "priority species of special concern" (Moseley and Groves 1992).

Shoshone sculpins occur sympatrically with mottled sculpins (*Cottus bairdi*) in 16 spring systems in the Thousand Springs formation (Wallace et al. 1984). Larger mottled sculpin are known to prey on smaller sculpin (Bailey 1952, Wydoski and Whitney 1979) and are considered a potential predator of Shoshone sculpin. The purpose of this study was to assess the extent to which Shoshone sculpin could be successfully introduced into an environment that seemed physically adequate but was already occupied by mottled sculpin.

METHODS

Shoshone sculpins were introduced into a small unnamed spring pond as part of an Idaho Department of Fish and Game nongame program to reestablish them in portions of their original range (Griffith and Daley 1984). The spring pond, referred to here as Transplant Spring, is 15.3 km upriver from Briggs Springs, the nearest spring inhabited by Shoshone sculpin at the time (Wallace et al. 1984).

Transplant Spring is approximately 1000 m² in surface area and enters the Snake River at river kilometer 965.7 in Gooding County, Idaho. Water flows from the spring head near the base of a basalt cliff over a 20-m-long cascade into a pond that is impounded by a set of culverts. The stream drops vertically 2 m into the Snake River after passing through the culverts. The discharge of Transplant Spring is influenced by a fish hatchery water diversion near the spring head.

Boulder and cobble substrate near the cascade shift to gravel, sand, and silt at the tail of the pool. There are dense patches of water speedwell (*Veronica* sp.) and cattail (*Typha* sp.). Amphipods, a group shown to be heavily consumed by Shoshone sculpin (Connolly 1983), were abundant (1000–5000 per m²) during the study. Taxa such as dipterans, trichopterans, and oligochaetes that also are utilized by Shoshone sculpin were present in densities similar to those

TABLE 1. Number of sculpins collected per 1-m² frame net and relative abundance (RA) electrofishing samples, and percent *Cottus greeniei* of total *Cottus* sp. at Transplant Spring, Idaho, 1983–91. Only fish >20 mm TL were included. On 15 August 1983, 419 *C. greeniei* were introduced into Transplant Spring.

Date	Method	<i>Cottus greeniei</i>			<i>Cottus bairdi</i>	
		Number collected	Number per frame	% total	Number collected	Number per frame
13 Aug 1983	11 frame nets	0	0	0	30	1–6
20 Nov 1983	10 frame nets	4	0–2	15	23	0–6
18 Feb 1984	RA	1	—	5	21	—
21 Apr 1984	RA	0	—	0	15	—
24 Sep 1984	RA	12	—	27	33	—
3 Oct 1990	RA	20	—	100	0	—
28 Sep 1991	4 frame nets and RA	96	3–29	98	2	0

in other springs supporting dense sculpin populations. Other fish species captured in Transplant Spring were mottled sculpin, rainbow trout (*Oncorhynchus mykiss*), and peamouth (*Mylocheilus caurinus*).

Shoshone sculpins ($n = 419$; mean length 36 mm TL, range 18–70 mm) were dip-netted and seined from Bickel Spring at the Hagerman National Fish Hatchery 25 km downriver from Transplant Spring on 15 August 1983 and stocked at Transplant Spring within a few hours. The sculpin population in the spring was monitored in August 1983 prior to the introduction, and after the introduction in November 1983, February, April, and September 1984, October 1990, and September 1991. The 1983 and 1991 samples were quantitative estimates using a frame net at 4–11 random sites. The 0.75-m-high boxlike PVC frame has 1-m² openings at the top and bottom, with 3-mm-diameter mesh netting attached to the sides. In the 1983 frame net samples, electrofishing (a Coffelt model BP-1C unit producing pulsed direct current) and dip nets were used simultaneously to capture fish within the frame net. In the 1991 frame net samples, the electrofisher was not employed within the frame net; instead, two dip nets were used until both netters made three consecutive passes without capturing a fish. On other sampling dates and in areas not sampled by the frame net, the electrofisher and dip nets were used to assess relative abundance of fishes.

Sculpins were identified and measured (TL) by viewing them through a water-filled plexiglas measuring board. This aquarium-like device enabled us to discriminate these small, morphologically similar fish while minimizing handling

stress prior to release. Sculpins less than 20 mm TL, which are age-0 fish (Connolly 1983), were not included in the analysis because they were not monitored in the 1983 and 1984 samples.

RESULTS

On 13 August 1983, prior to the stocking of Shoshone sculpins, mottled sculpins were in all frame net samples and distributed throughout the spring pond. Most individuals were small or intermediate in size (33–97 mm TL). An average of 2.7 mottled sculpins was captured per frame net sample (Griffith and Daley 1984).

After the introduction of the Shoshone sculpin, 27 individuals were collected in 1983 and 82 in 1984 (Table 1). Mottled sculpins were present at both the vegetated habitats and the rocky habitats in 1983 (Griffith and Daley 1984). The abundance of Shoshone sculpins relative to the total number of sculpins, both Shoshone and mottled, was 15% in 1983 and 16% in 1984. Five age-0 Shoshone sculpins were found in September 1984 (Griffith and Daley 1984), indicating that some Shoshone sculpins reproduced successfully. On 3 October 1990, 20 sculpins were collected, all of which were Shoshone sculpin, ranging from 28 to 70 mm TL.

On 28 September 1991, 100 Shoshone sculpins were collected from frame net samples and electrofishing (Table 1). In four frame samples there were 53 mature (up to 80 mm TL) and 4 age-0 (≤ 20 mm TL) Shoshone sculpin, averaging 14.3 ± 11 (mean \pm standard deviation) individuals/m². Forty-three other Shoshone sculpin were electrofished along the perimeter of the pond. Highest Shoshone

sculpin densities among *Veronica*, where one frame net captured 29 fish. Two mottled sculpins were found in cobbles and boulders where the spring cascades into the pond.

DISCUSSION

Shoshone sculpin has become the predominant fish in Transplant Spring in less than an 8-year period. That period represents two or three generations, based on typical longevity of 3–4 years (Connolly 1983). Reproduction was successful in 1984, but a substantial increase in population size was not recognized until 1990. Unfortunately, we have no data from 1985 to 1989 to assess the rate of change. Frame net sampling was probably more thorough in 1991 than methods used in 1983, which may have underestimated densities, although we believe the bias was minor.

A smaller, unnamed spring entering the Snake River 0.1 km downstream from Transplant Spring also was colonized recently by Shoshone sculpins. Nine fish were captured there with an electrofisher in September 1991. When the spring was sampled in 1981–83, only mottled sculpin and rainbow trout were found there (Griffith unpublished data). We suspect that Shoshone sculpins may have migrated the short distance downstream from Transplant Spring.

Shoshone sculpins introduced to Transplant Spring were able to reproduce, compete, and survive in the spring environment in the presence of the larger mottled sculpins. Other sympatric sculpins show habitat segregation by selecting different substrates, water velocities, depths, or temperatures. In Oregon streams the reticulate sculpin (*Cottus perplexus*) occupied riffles and pools in the absence of other sculpin species (Finger 1952). In the presence of the Paiute sculpin (*Cottus beldingi*), the larger reticulate sculpin used pools more frequently. Matheson and Brooks (1983) found that mottled sculpin in Virginia streams preferred colder water than did the Potomac sculpin (*Cottus girardi*), which occupied slow water velocity and silty substrates. In California the rough sculpin (*Cottus asperimus*) selected deeper water (>20 cm) than did the Pit sculpin (*Cottus pitenae*) and marbled sculpin (*Cottus klamathensis amoenops*) (Brown 1991). Rough sculpins typically occupy spring-fed streams, and they are physiologically limited to a narrow range of tem-

peratures (Brown 1989). Rough and Shoshone sculpins both utilize the unique habitat provided by springs, and both have a limited geographic distribution.

Density data from Transplant Spring suggest that Shoshone sculpins may have been able to occupy or utilize habitat with lower water velocities or dense vegetation more effectively than mottled sculpins. Daley et al. (1982) observed that Shoshone sculpins rarely occupied areas with surface velocities greater than 60–80 cm/s. The highest densities of Shoshone sculpin typically occur in aquatic vegetation (Daley et al. 1982, and this report). When Shoshone sculpins were absent or less abundant in Transplant Spring, mottled sculpins utilized aquatic vegetation and low water velocity areas (Griffith and Daley 1984); apparently, however, they were displaced from this habitat, but not from the cascade at the pond head, by Shoshone sculpins.

Mottled sculpins primarily utilize rocky substrates and moderate water velocities (Bailey 1952, Wydoski and Whitney 1979, Page and Burr 1991). Mottled sculpins in North Carolina streams selected habitats with mean focal point velocities of 48–88 cm/s, and 71% of the sculpins occupied sites with overhead rocky shelters (Facey and Grossman 1992). It appears that Shoshone and mottled sculpins may segregate based partially upon water velocity.

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